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Reprint from THE TEXAS JOURNAL OF SCIENCE, Vol. XVIII, No. 1, May 1966

nematodes were dead. Uncontaminated plates continued to support active larval and adult stages of this nematode. Metcalf (*Trans. Am. Microscop. Soc.* 24: 89–102, 1903) has reported a similar observation involving the nematode *Rhabditis brevispina* and commented that study of black *Aspergillus* by-products might reveal a useful nematode control agent. The purpose of this study was to determine whether the *Aspergillus* had a direct lethal effect upon the nematodes or whether it destroyed bacteria on which the nematodes feed secondarily caused mortality through starvation.

Two series of experimental plates were used. Series A composed of 10 potato dextrose agar plates, contained *Aspergillus* sp., *P. chitwoodi,* and bacteria taken directly from the sludge drying beds. Series B was composed of 10 plates containing *Aspergillus* sp. filtrate, *P. chitwoodi,* and bacteria. The filtrate was prepared by taking blocks of agar from plates containing pure *Aspergillus* cultures and letting them stand in sterile distilled water for 30 minutes. Therefore, the filtrate contained the water soluble products only. Two sets of control plates were used. One set consisted of 10 plates containing *P. chitwoodi* and bacteria; the other contained *Aspergillus* and bacteria. All plates were incubated at room temperature and checked daily for massive lethal effects on the worms. Daily tests for bacterial viability were conducted by streaking bacteria from experimental and control plates onto potato dextrose agar and incubating at room temperature.

Bacteria were found to be viable and abundant in both controls and both experimental series. However, after 12 days all nematodes in the experimental plates were killed. In Series B death began about the second day following inoculation and all nematodes were dead in 5 days. In Series A death began about the 5th day and all nematodes were killed by the 12th day. No apparent resistance according to age was indicated since all developmental stages of the nematode were found. Even L_1 larvae *in utero* showed no visible signs of movement. In the absence of *Aspergillus* contamination *P. chitwoodi* could be kept on the original potato dextrose agar plates for 30 days or longer with occasional addition of tap water to the medium.

Final pH readings were taken for each series used. Changes in pH of the medium seemed insufficient to cause the massive lethal effects. The final pH readings were:

1) Series A. . . . . (*Aspergillus,* nematodes, bacteria) 5.2
2) Series B. . . . . (filtrate, nematodes, bacteria) 5.0
3) Control . . . . (*Aspergillus,* bacteria) 4.8
4) Control . . . . (nematodes, bacteria) 5.4
5) Sterile potato dextrose agar 5.6

The data suggest that the *Aspergillus* effect was a direct one and that the filtrate contained the killing potential. The mechanism causing the deaths is unknown. Under natural soil conditions the concentration of the filtrate may not reach toxic levels. Under the experimental conditions it is possible that mortality may have resulted from a concentration of the filtrate materials. Identification of the filtrate products and the mode of action on the nematodes poses an interesting problem for future investigation. *John L. Murad, Texas A & M University. Present address: Department of Zoology, Louisiana Polytechnic Institute, Ruston, Louisiana.*

A NEW LOCALITY RECORD FOR THE LANCELET, *BRANCHIOSTOMA CARIBAEUM* (SUNDEVALL), ON THE TEXAS COAST. A survey of the literature reveals that the lancelet, *Branchiostoma caribaeum* (Sundevall), ranges from Chesapeake Bay to the northern Gulf of Mexico from Florida westward to Aransas Pass, Texas. Distribution records for *B. caribaeum* along the Gulf coast are sporadic. Bigelow and Farfante (*In*: Fishes of the western north Atlantic. Pt. 1. *Sears Found. Mar. Res.*, 1–28, 1948) stated that this lancelet occurs occasionally in large numbers on the coast of western and northwest Florida (as far as Pensacola). These authors considered *B. floridae* (Hubbs, *Occ. Pap. Univ. Mich.*, 105: 1–16, 1922), to which specimens from this area were previously assigned, a synonym of *B. caribaeum* and listed the range as extending from Chesapeake Bay to the West Indies. A small collection of lancelets made by T. E. Pulley in Lydia Ann Channel in Aransas Bay, Texas, was identified as *B. caribaeum* by Gunter and Knapp (*Tex. J. Sci.*, 3(1): 134–138, 1951). They (*op. cit.*: 138) also reported a collection of four taken by Mr. Cleburne A. Shultz from near the pier at the Institute of Marine Science, University of Texas, at Aransas Pass, Texas, and presumed them to be *B. caribaeum* although

positive identification was not made. Hefley and Shoemaker (*Science*, 115(2976): 48, 1952) reported additional lancelets from the Chandeleur Islands of Louisiana and the Mississippi coast. This species has not previously been reported, however, from Gulf coastal waters between Aransas Pass and the Chandeleur Islands.

On July 17, 1963, 12 lancelets were captured in an Ekman dredge at the junction of the Gulf Intracoastal Waterway and the Houston Ship Channel in Galveston Bay, Texas, at Latitude 29° 21.8′ N., Longitude 94° 47.8′ W. The average depth was 42 feet and the bottom sediment was sandy fragmented shell with small amounts of silt and clay.

In removal of the sample from the dredge, a number of lancelets were found protruding about ¼ inch above the surface of the sediment. These lancelets ranged from 40 to 44 mm. long and averaged 42 mm.; weight ranged from 0.15 to 0.20 gram and averaged 0.18 gram. The identification of these specimens, *Branchiostoma caribaeum* (Sundevall), was confirmed by Robert H. Kanazawa, Division of Fishes, Smithsonian Institution. *Cornelius R. Mock, Bureau of Commercial Fisheries, Galveston, Texas. Contribution No. 197, Bureau of Commercial Fisheries Biological Laboratory, Galveston, Texas.*

Abstracts of Papers Presented at the Sixty-Ninth Annual Meeting of the Texas Academy of Science, Dallas, Texas, December 9–11.

SECTION I: MATHEMATICS

Symposium on Problems of Orbital Rendezvous

GENERAL CONSIDERATIONS ABOUT ORBITAL RENDEZVOUS. Charles R. Price, Manned Spacecraft Center.

The accelerations required for intercept and velocity match of a passive orbiting target by an active spacecraft can be determined by solution of Kepler's Equation and Lambert's Problem using transit time as the independent variable. Although this is a complete academic solution, operationally a rendezvous mission is constrained by onboard fuel capability and systems lifetime. A safe minimum altitude and hardware errors also affect the implementation of rendezvous.

The rendezvous mission can be divided into three segments for reference: 1) phasing for intercept injection (this includes launch off the surface), 2) midcourse navigation and guidance, and 3) reduction of closure rate and docking. Four specific examples of orbital configurations for a lunar rendezous for use in Project Apollo are: 1) direct intercept, 2) low orbit phasing coast, 3) bi-elliptic, and 4) concentric flight plan.

RENDEZVOUS GUIDANCE THEORY. J. H. Suddath, Manned Spacecraft Center.

A simple example problem is used to illustrate some of the fundamental considerations of rendezous guidance theory. The problem, which is the rendezvous of two beads sliding on a wire, is complicated by uncertainties in the state of the system, and errors made in implementing "guidance" corrections. A guidance logic, which accounts for the uncertainties, is developed on the basis that a set of a priori statistics is given for the problem.

RECENT ADVANCES IN PILOTED RENDEZVOUS SIMULATIONS. Ronald W. Simpson, Manned Spacecraft Center.

Early rendezvous simulations were conducted primarily to prove the general feasibility of the space rendezvous maneuver. These early simulations were simplified studies because (1) funded projects requiring space rendezvous development did not exist at the time and (2) computing equipment available would not allow a full scale piloted rendezvous simulation to be conducted in real-time.

Two major advances in simulation technology have paved the way for more sophisticated real-time rendezvous simulations to be conducted. The first of these advances—hybrid computation—made it feasible to simulate the long-period dynamics of a rendezvous maneuver over extended periods of time without sacrificing problem accuracy because of system drift. Hybrid computation also provided the wide range of scaling necessary for simulation of the complete rendezvous maneuver. The second major advance in simulation technology was in the area of visual pilot displays. The virtual image display system provides the rendezvous simulator pilot a three dimen-